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MORPHOLOGY AND BIOLOGY OF THE MEMBRACIDÆ OF KANSAS,
Hazel Branch.

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Morphology and Biology of the Membracidæ of Kansas.*

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(Submitted in partial fulfillment of the requirements for the degree of master of arts.)

Plates V to XXI.

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MEMBRACIDÆ:

1.—Morphology and Ecology of *Entylia sinuata* Fab.

2.—Taxonomy of Kansas Forms.

* This is one of a series of studies on Kansas Homoptera. The head of the department has assigned each of the different families to a graduate student. Some of these have already been published, others are to follow.

MEMBRACIDÆ.

(Order HEMIPTERA.—Suborder HOMOPTERA.)

The family Membracidæ, although entirely phytophagous in its habits, confines itself for the most part to weeds and grasses. It is not a large family, as it includes not more than 1500 described species, but it is of wide distribution.

Geographical Distribution.

Frogatt states that the Membracidæ is a group confined to the tropical regions and well represented in Australia, but better in South America, where the forms are large and more profuse. Notwithstanding this statement, this family is found all over the United States and Canada, Great Britain, Australia, New Zealand, Philippine Islands and New Guinea, Sumatra and Ceylon; in Brazil, Amazons and Ecuador; on temperate slopes of the Himalaya mountains, and on high ground in Central Africa. The distribution seems to follow the isothermal lines of temperature rather than the boundaries of the zones. However, a peculiar instance is noted in that Europe, excluding the British Isles, is void of the family, with the exception of three species of *Centropida.*

On account of its jumping habits, it is difficult to collect, and there are many localities, no doubt, where the form remains unobserved. Those forms in the tropics are more prolific than those in the temperate zones; are larger and of more brilliant colorings than the more northern species.

In the United States the following states have reported collections: Alabama, Arizona, Colorado, North Carolina, California, Florida, Georgia, Vermont, Missouri, Oregon, Virginia, New York, Texas, New Jersey, Wyoming, Illinois, and Kansas.

In Kansas the following counties have yielded specimens: Neosho, Reno, Douglas, Finney, Rawlins, Gove, Cheyenne, Cowley, Sedgwick, Woodson, Wilson, Allen, Seward, and Sheridan.

Description of Family.

The family Membracidæ, commonly called tree hoppers, belongs to the suborder Homoptera of the order Hemiptera, and is placed by Buckton between Cicadidæ and Cercopidæ. The classification as given by Comstock in "Introduction to Entomology" is as follows:

Beak evidently arising from the mentum; tarsi three jointed; antennæ minute, setiform; ocelli only two in number or wanting; males without musical organs; prothorax prolonged into a horn or point above the abdomen ..... MEMBRACIDÆ.

The head is usually perpendicular, and when viewed from the front appears somewhat triangular, with large globular eyes protruding on either side. On the face or cephalic aspect of the head and between the compound eyes are situated the two small ocelli.

In all genera the prothorax is abnormal, being produced upward and backward or forward into numerous shapes. In the Kansas forms, at least, it extends well back over the abdomen, concealing the mesothorax and metathorax, and frequently continuing as far back as the tips of the tegmina. It rises from the head in a perpendicular line, and is as wide as the head, extending back of the compound eyes and under the mesothorax for a short distance, by means of small lateral arms. (See fig. 34, pl. X.) Frequently the prothoracic legs are removed with the prothorax, as they are connected to the lateral arms by a delicate membrane. Back of the compound eyes the prothoracic lateral margin rises and turns caudad suddenly under the suprahumerals, thus forming the lateral angles, or humeri. (See fig. 7, pl. VI.) Fastened into this angle is a tiny sclerite, which seems to help in the protection of the tegmina.

In the prothorax there are four main divisions, the metopidium, procephalon, dorsum, and posterior process, although there are no definite sutures to mark the divisions.

METOPIDIUM is the sloping portion of the front of the prothorax extending from the head to the front of the dorsum, and bearing the suprahumeral processes (fig. 5, *a*, pl. VI). It may extend in a horn over the head as in *Campylenchia curvata* (fig. 11, pl. VII), or it may be void of any protuberance on the top. The suprahumeral processes are the lateral protuberances seen at the sides over the compound eyes and humeri (fig. 5, *e*; fig. 7, *x*, pl. VI). These suprahumerals are variable in shape, and are sometimes so obscure as to appear absent until the hand lens is used. The procephalon is the portion above the metopidium. In the exotic forms it may extend backward as a horn and be branched into several spines, but among the Kansas species this form is not found. The procephalon is not present in our forms except in the two genera *Enchenopa* and *Campylenchia* (figs. 11, 12, pl. VII). The dorsum is the portion from the suprahumerals to the tail. It is convex in the Kansas forms and without any

processes, usually surmounted by a prominent longitudinal median carina.

Posterior process is the sharply constricted portion at the caudal extremity of the prothorax. It continues, frequently, to the tips of the tegmina, and usually ends in a sharp, black point. (Fig. 5, at *c*, pl. VI.)

The prothorax is almost always pitted and is sometimes pilose. It is highly developed and may take on various shapes and forms; in fact, the family has been likened to Brownies on account of the queer facial expression and the grotesque appearance of the prothorax. There are some forms with two "humps," one caudad, or back of the other, as in *Entylia sinuata* (fig. 61, pl. XVI), while other forms bear only one spine or "hump," as in *Enchenopa binotata* (fig. 13, pl. VII), and *Campylenchia curvata* (fig. 11, pl. VII).

In some cases this single protuberance may be over the head and be a formation of the metopidium, called the procephalon, as in the two foregoing species; or it may be a crest on the dorsum over the abdomen, as in *Telamona* (fig. 31, pl. VIII; fig. 73, pl. X). Frequently the pronotum rises high in front, and by sloping backward from the metopidium forms a high tectiform hood over the abdomen, sloping down posteriorly to the posterior process, as in *Archasia* (figs. 22, 23, pl. IX) and *Stictocephala* (fig. 17, pl. VII; fig. 29, pl. IX).

In all the above-mentioned forms the suprahumerals are obtuse and minute, but in *Ceresa* the prothorax bears a prominent lateral horn on either side just back of the head (figs. 5, 6, 9, 10, pl. VI). In a few cases the pronotum may not present any protuberance except obscure suprahumerals, and the metopidium may rise only sufficiently high to cover the thorax. It thus seems to form a close protection for the thorax and abdomen, as in *Micrutalis* and *Acutalis* (figs. 18, 19, 20, 21, pl. VIII) and *Vanduzea* (figs. 14, 15, pl. VIII). Among the genera, other than those found in Kansas, the pronotum may not cover the abdomen, and in some cases does not conceal the mesothorax and metathorax, but ends in elevated and protruded spines or balls of odd shapes.

TEGMINA. The tegmina are elongate or lanceolate, membranous throughout, transparent in the main, but sometimes coriaceous and smoky in regions. The tegmina are unequally divided into corium, or embolium, and clavus (see fig. 75, pl.

XIX), which are separated by a fold (indicated in the drawing by a dotted line). The *corium* is the anterior portion of the tegmen, and, according to Goding, has a costal and three longitudinal veins proceeding from the base. In no case in the Kansas forms does this hold good, there being no more than two longitudinal and the costa, and frequently only one longitudinal, and the costa, proceeding from the base of the corium. Goding names the veins as costa, radia, and two ulnar. In case of *Cyrtolobus vau* and *Campylenchia curvata*, this is consistent if the two ulnars are fused at the base, but in the majority of forms there is but one vein other than the costa proceeding from the base of the corium.

In the study of the nymphal pad some of this fusing and the disappearance of several veins is cleared up. In the nymphal pad there are two veins in the costal region, the costa and subcosta; these fuse in the adult and are usually referred to as the costa. (See fig. 75, pl. XIX.)

Frequently, as in *Ceresa bubalus*, the one longitudinal vein, other than the costa, is branched soon after leaving the base, and forms the radial and one ulnar vein. In the nymph pad is found one other vein "media," which is fused with the radia in the adult.

The *clavus* has usually two anal veins, one of which frequently forms the posterior margin of the tegmen for some distance; the other anal vein usually joins the marginal vein at about its middle point. Much more discussion of the veins in tegmina of different species could be given, but observations on the drawings of the tegmina will give a conception as to the variation of the venation.

Cells of the tegmen (and in this instance I take *Ceresa bubalus* as a typical illustration, as it appears to be nearly constant) have four basal cells, the third of which is frequently referred to as the sutural area, as it contains the sutural fold between the clavus and corium. (See fig. 75, pl. XIX.) The costal cell in all forms is long and slender, proceeding to the first apical cell without the intervention of a discoidal cell.

The cells between the apical cells and the basal cells are known as *discoidal cells*, and usually number three.

The apical cells are typically five in number, although some genera may have only four, as in *Micrutalis*. These cells are marginal and are surrounded by nervules, no nerves or nervules

extending to the outer edge of the tegmen in this region; but are surrounded by an unveined membrane, the limbus. (See fig. 75, pl. XIX.) The third apical cell is characteristic in genera, and often forms the basis for classification. The tegmina are not covered laterally by the pronotum, but are free, united to the thorax below the humeri of the pronotum. When at rest, the tegmina lie with the costal region downward, as in the Aphididæ.

THE WINGS are more or less spatulate and broad; smaller than the tegmina, the anterior margin being about equal to the posterior margin of the tegmina. When at rest the wings are folded once and lie between the tegmina and abdomen, the costal region downward.

The wing is uniformly transparent and clearly veined. Here is again found the division into the corium and clavus, the corium usually having the costa and two other longitudinal veins (radia and ulnar) proceeding from its base. Here the costa does not always form the anterior margin as in the tegmina, almost the entire nerve area being bounded by the narrow limbus.

In the clavus are two anal veins, the second of which frequently lies in the posterior margin. There are three and sometimes four basal cells, in the third of which is a sutural fold. There are no discoidal cells, and frequently only three apical cells, although there may be more in some genera.

THE HIND LEGS are fitted for jumping. The femora are cylindrical and curved, the tibiæ quadrangular, prismatic or spatulate. In the metathoracic leg the tibia is densely spined, with the points of the spines downward, toward the end of the claws. The tarsi are composed of three segments, the first one longer than the other two. The last segment of the tarsus ends in a pair of sharp, black claws. (Fig. 2, pl. V.)

COLOR. Buckton figures some of the species in brilliant reds, yellows, and vivid greens, but the Kansas forms are modest in their colorings. Some few are pale green when alive, as *Ceresa bubalus, Ceresa taurina, and Stictocephala,* turning tawny when dried. A great number are mottled brown and tan, with touches of black or white, sometimes both. (See *Entylia sinuata,* figs. 61, 62, pl. XVI; *Ceresa diceros,* fig. 6, pl. VI; *Vanduzea,* fig. 15, pl. VIII; and *Telamona,* fig. 73, pl. X.) The only bright colors met with in the Kansas species occur in

the ocelli, which in life are usually a cherry red, and frequently remain so when dried. *Enchenopa binotata* (fig. 13, pl. VII) has two yellow spots near the region of the median carina. Some species are polished black, and may be outlined with palish yellow, as *Micrutalis calva,* while others are a dull black with rouch surface. A few forms, *Micrutalis occidentalis,* for instance, are frequently orange with more or less dark marking toward the head. *Publilia modesta* is diamorphic, and during a season may produce forms almost white with a downy surface.

SIZE. According to Buckton the forms may be as large as two English inches (about 50 mm.) in wing expanse; but 20 mm. will include our largest species, *Ceresa bubalus* and *Talamona ampelopsides,* which are 9 to 10 mm. from tip of tegmina to front of head. Our smallest species, *Micrutalis occidentalis,* is not more than 3 mm. in length. The sizes vary greatly within the species, and the male is almost invariably smaller than the female.

LIFE HISTORY OF ENTYLIA SINUATA.

PLATE XVI.

As far as the writer has observed or can ascertain from reports, the genera of the Kansas forms of Membracidæ live on the leaves and twigs of shrubs, bushes, and weeds. No form has been found living in ants' nests, as the members of the subfamily Tragopidæ do, but numerous species of ants are found on the vegetation with the Membracidæ, supposedly attending to their wants and being repaid in honey dew exuded from the anus. At least three species of Formicidæ have been collected with Membracidæ, namely *Formica fusca,* and another of the same genus, but the species is not determined; the third is *Prenolepis imparis.*

Entylia sinuata are found in great numbers upon the under sides of the leaves of *Cnicus altissimus* Willd.

NOTES. Food plant, *Cnicus altissimus.* Place, a shady grove on the east slope of a hill. Temperature records were kept on a self-recording thermometer, and during the observations, from June 29 to July 23, the minimum was 72° F.; the maximum 91.9° F.

On June 29, 1909, a pair is noted. In the morning (June 30) the male is missing, but the female sits quietly on the

midrib on the underside of the leaf with her head pointed toward the apex of the leaf. In the evening of the same day the female is missing, and two dark longitudinal, parallel lines about 10 mm. in length are discernible on the midrib. With a hand lens (12 ×) the eggs can be made out. They are embedded in the midrib, but the ends of the eggs are visible, appearing clearly and of a white color. (See *a*, fig. 56, pl. XVI.)

There is no perceptible change until four days later (July 4), when the slits are found burst open and the sides of the eggs are exposed to view. (Fig. 56, pl. XVI, at *B*.)

On the ninth day of July the slit is spread further, and hatching is in progress. The egg is ⅞ mm. in length, and has a small protuberance at the "hatching end," which is the last end to leave the ovipositors and is that portion visible in the midrib after the egg has been deposited.

When first hatched the nymph is pale yellow, or nearly colorless, but after a period of thirty minutes the color and markings begin to appear. The head, first thoracic segment and tip of abdomen become dark brown, while dark markings are noticeable on the second, third, fourth and fifth rings of the abdomen. The other portion of the dorsal aspect of the body is pale green. The ventral portion of the thorax and abdomen is white, with legs of a pale, transparent yellow. Each of the abdominal segments, except the first, bares two dorsal and two lateral spines or tubercles, one on each side, tipped with black hairs. The second and third segments of the thorax (the undeveloped mesothorax and metathorax) bear hairs in place of spines. The mesothorax, though light in color, bears a dark spot on the front edge. On the cephalic or front edge of the head are four hairs, and there is a hair cephalad and one caudad of each compound eye. The nymph, when one hour old, measures 1⅓ mm. and is extremely active.

The antennæ are pale and transparent, delicately haired, and are very nearly equal to the length of the antennæ on the adult forms, being about one-half the length of the nymph. (See fig. 58, pl. XVI.)

The prothoracic segment, which is dark brown, is a third wider than the mesothoracic segment and as wide as the head. This prothoracic enlargement is, no doubt, the beginning of the overdevelopment of the prothorax to be seen in the maturing

and adult forms. In this first instar, it is interesting to note that there is an articulation between this segment and the head. The head, which is dark and shiny, is extremely large in proportion to the body; in fact, it is larger in a line from back to front in dorsal aspect than in the adult forms. (Fig. 58, pl. XVI.)

The *mouth parts* are enlarged out of all normal proportion, the distal end of the beak reaching to the end of the sixth abdominal ring. (See fig. 57, pl. XVI.) The ocelli are found in about the normal position.

On the twelfth day (counting from the date of oviposition and on the third day of the life of the nymph), July 12, occurs the first moult. In this second instar the enlargement of the prothorax takes on a shape similar to that in the adult form, except that it does not extend back over the abdomen, but it does extend far enough to cover the mesothorax. The prothorax bears the shovel-like horn and the notch which forms the dorsal hump. The head is reduced in size in this instar. The second, third, fourth, fifth, sixth, seventh and ninth abdominal segments bear two dorsal hirsute spines, the lateral ones having disappeared. The third, fourth and fifth segments are marked with dark dorsally and about half way down the lateral face. The nymph, in the second instar, measures 2½ mm. in length.

A curious fact noticed is, that in the nymphal stages the forms do not exhibit any jumping power, but run very rapidly. When four days old the measurement is 3 mm., but they have not moulted.

On the fifth day after hatching (July 14) the second moult occurs. In this third instar a differentiation of color is observed. A number of the forms are dark with black "hoods," while others are light with tan hoods. Upon further observations, this color difference seems to be the indication of the sex to be formed in the adult stage, the dark ones emerging as males and the light ones as females. In this instar also the wing pads appear. (See fig. 59, pl. XVI.) When nine days old (July 18) the third moult occurs. In this fourth instar we have the stage which is comparable to the pupa stage in forms having complete metamorphosis. In figure 60, plate XVI, is seen the "pupa," with the prothoracic enlargement spilt open ready for the emergence of the adult. This emer-

gence occurred when the nymph was fourteen days old (July 23). The imago is transparent, of a pale greenish-gray tinge, void of markings. It is active and will jump immediately upon emerging. Some were observed kicking off the old shell or jumping away from it. Within twenty minutes or half an hour the color markings begin to appear, and in less than an hour the imago is not discernible from the individuals many days older.

SUMMARY.

Egg stage		9 days
Larva stage—First instar		3 days
	Second instar	2 days
	Third instar	4 days
Pupa or fourth instar		5 days
Total		23 days

Twenty-three days are necessarily consumed from time of the oviposition of the egg until the form reaches the adult stage. As nine days are used in the development of the embryo, we have two weeks as the time from hatching until the form emerges as an imago. Mrs. Rice, in her report on the life history of *Entylia sinuata*, states two weeks as the time from hatching to adult stage if ants are present, and one week if undisturbed by ants. In my experiments indoors, without the presence of ants, the forms seemed unable to moult successfully and died before reaching maturity. This fact leads me to believe that the ants are necessary factors in the life of an individual membracid.

From three to four days after emergence the female commences to lay eggs. It has not been absolutely ascertained, but has been more or less satisfactorily observed, that one female lays more than one egg during her life, each mass averaging about thirty-five eggs.

The number of eggs is also indefinite, but as forms have been observed late in May and nymphs found as late as the first of November, and as it takes approximately four weeks from the time an egg mass is laid until a female from that generation begins to deposit her eggs, the writer feels justified in estimating six or seven broods in a season.

As to the winter state, it is conjectured that it is spent either in the egg stage or as adult, protection being obained from the fallen leaves. On October 24 adult forms, a few nymphs in the pupa stage and newly emerged adults were observed, not-

withstanding the occurrence of two heavy frosts. On November 1 several nymphs and adults were found on a food-plant stalk which had been taken to the laboratory for search of egg masses. No evidence of the theory that the form passes the winter in the egg stage has been ascertainable up to this date.

MORPHOLOGY.

EXTERNAL ANATOMY.

Head.

The head of a membracid is arranged in two planes; one vertical and parallel with the transverse planes of the body of the insect, the other set at an angle of about 95 degrees, or little more than a right angle, to the vertical plane. (Fig. 38A, pl. XI.)

This vertical plane (which is continued by the cephalic face of the metopidium), when viewed in cephalic aspect, appears as an isosceles triangle. The suture between the head and the metopidium of the prothorax forms the base, and the globular eyes form the equal angles. The ventral edge of the face, which is formed by the clypeus, is the vertex of the triangle; the sides of the loræ extend from clypeus to compound eye, and form the sides of the triangle. (See fig. 62, pl. XVI.)

Before the head can be viewed in its entirety the prothorax must be removed, as the top of the head is concealed by the præscutum. The suture, although in an approximately straight line, slopes slightly downward toward the sides, thus giving the base of the metopidium a curved appearance. (See fig. 62, pl. XVI.) This suture is not articulate in the adult forms, and although easily opened, care must be taken in removing the prothorax, as there are tiny arms produced from the front of the lateral angles of prothorax, which surround the head back of the compound eyes. Frequently, if these arms are not first broken away, the head will pull off with the prothorax. These arms extend almost around the union of the head with the thorax, and reach to the coxæ of the prothoracic legs, to which the arms are attached by a delicate membrane. (Fig. 34, pl. X.) The prothorax removed, the head or cephalic aspect thereof can be viewed. This ventral plane is flat when viewed laterally, but is really curved slightly backward on the sides, the middle of the curve being the central line dividing the face into bilateral halves. In this aspect three divisions

of the head can be seen, namely: Epicranium, clypeus, and loræ. (Fig. 35, pl. XI.)

THE EPICRANIUM, in the generalized insect, is the dorsal part of the head lying back of an inverted Y-shaped suture (Comstock and Kochi). In this family the suture is clearly marked, the main suture branching at the top of the clypeus and the arms of the suture formed by the lateral edges of the clypeus. The top of the epicranium is almost flat, although there is a slight indentation at the suture and the line curves down slightly to meet the compound eyes. In dorsal view (fig. 1, pl. V) the epicranium narrows from front to back, rolling gently backward and then dropping suddenly to the occiput (fig. 40, pl. XII). The vertex of the epicranium is just back of the suture between the head and prothorax.

The compound eyes are considered the outgrowth of the epicranium, and are situated at the extreme lateral edges of the sclerite. They are large and globular and composed of thousands of hexagonal facets. As the ventral surface of the eye contains approximately as many facets and is as large in area as the cephalic surface, it would seem that the downward vision of the insect would equal its forward vision. (Fig. 35 at *c*, and 37A at *c*, pl. XI.)

Ocelli.—Situated in the front of the head, in an unsutured division of the epicranium, named the *Frons*, and nearer the clypeus than the vertex, lying either side of the epicranial suture, are the brilliant little ocelli. (Figs. 35 and 37A at *o*, pl. XI.)

LORÆ. Separated by no apparent suture, but nevertheless a division of the epicranium, are the loræ. Their lateral edges extend from the base of the compound eyes to the ventral point of the lateral edge of the clypeus. This division line is about midway of the lateral edge of the clypeus in an oblique line upward to the base of the compound eye. There is thus formed a small triangle with two long and one short side, the short side being next to the clypeus. (Fig. 35 at *l*, pl. XI.)

CLYPEUS.* This sclerite has been discussed and pointed out by the foregoing descriptions until it needs very little explanation. In this cephalic aspect it is triangular and with a curved base, the apex of the triangle at the epicranial suture.

* In the nomenclature of the mouth parts the author follows Muir & Kershaw (28) in that she considers what many systematists call frons, clypeus and labrum, respectively the clypeus, labrum and epipharynx.

The ventral edge is densely hirsute. The whole cephalic face is deeply pitted or punctate and frequently mottled with dark patches. (Fig. 35 at *y*, pl. XI.)

The plane at an angle of 95 degrees to this cephalic face is also a triangle, the base being the ventral edge of the cephalic face and the apex the distal end of the epipharynx. (See Fig. 37A, pl. XI.)

In this plane are found the mouth parts proper, and here are situated all the typical sclerites of a suctorial mouth, namely, clypeus, labrum, epipharynx, mandibular and maxillary sclerites with their respective setæ, and the labium or beak.

Situated also in this plane are the genæ or cheeks, and the antennal sockets with the delicate antennæ. The compound eyes are also visible in this plane. When at rest the beak lies between the coxæ of the legs of the insect and close to the sternum, but when in use it is lowered onto the food plant by special muscles.

THE GENÆ (fig. 37A at *g*, pl. XI) are irregular quadrangular plates surrounded by the compound eyes, the mandibular and maxillary sclerites and the overhanging loræ. These genæ, with the maxillary sclerites, form the lateral edges of this plane of the head.

ANTENNAL SOCKET. (Fig. 35 at *x*, pl. XI.) Situated on the inner edge of the genæ, and lying against the ventral face of the clypeus and under the overhanging edge of the loræ, is the circular socket or antennal sclerite, its edge next to the genæ being the quadrant of a circle.

ANTENNÆ. (Figs. 36 and 37A, pl. XI.) The antennæ are pale in color and extremely minute and bristle-like. So minute and delicate are they that they are scarcely discernible with a pocket lens; in fact, they are frequently absent in mounted specimens, as they are easily broken off.

The antenna, which measures 0.45 mm. in length, is composed of three segments—two stout basal segments (*m* and *n*, fig. 36, pl. XI), the second and heavier of which bears sensoria; the third segment is spur-like, having a thickened base and gradually becoming slender until the distal end is hair-like. This spur, although unsegmented, has more than fifty small divisions, the last one much longer than the others. (Fig. 36, *x*, pl. XI.) The antennæ are very deeply set into the socket,

there being found upon dissection an interior spine nearly as long as the two basal segments.

In caudal aspect the head presents a concave surface, smooth and unhaired or punctured. Only small margins of the compound eyes can be seen. (Fig. 40, pl. XII.)

Branching out from the occipital plates which surround the cavity are seen the tentoria (*t*, fig. 40, pl. XII) ; from these is a narrow chitinized bar with three pairs of branches—one pair inward to support the œsophagus and attached to the cephalic face, just above the suture for clypeus, the second pair toward the thorax to help join the head to the thorax, and the third pair join to meet the bar which supports the labium.

Mouth Parts.

In ventral aspect (fig. 37A, pl. XI) the clypeus appears as a fleshy, swollen cushion, very large in proportion to the other sclerites, and rising in a dome. It is haired and its lateral edges fit down tightly upon the other sclerites. (See fig. 37A at *y*, pl. XI.)

LABRUM. Lying against the distal edge of the clypeus is the labrum, light in color, and also fleshy and slightly elevated, but smooth and unhaired. It is elongated, with lateral edges curving inward distad. (See *lb*, fig. 37A, pl. XI.) In its under side the edges are seen to curve inward to support the epipharynx. The distal edge is pilose.

EPIPHARYNX. Arising beneath and extending beyond the labrum is the external portion of the epipharynx. It is pointed, and grooved on its inner surface, fitting closely over the opening in the first segment of the beak, and making, with the labium, an almost perfect tube (fig. 38B, pl. XII) for the setæ, which come together and enter the beak at this point. It extends exteriorly to the joint between the first and second segments. (Fig. 37A, pl. XI.) On its inner or under side the epipharynx is grooved and extends in a slender, thin plate to the hypopharynx, which will be discussed later. (Fig. 39, pl. XII.)

MANDIBULAR SCLERITES. (Fig. 37A at *m*, pl. XI.) Lying laterad of the clypeus is a slender, curved plate immovably sutured with the clypeus. Muir and Kershaw seem to consider this sclerite as a lateral projection of the clypeus. They figure a mandibular suture but no scelerite. I find this suture between the clypeus and the projected plate of

Muir and Kershaw easily opened and the two sclerites separated. In figure 42, pl. XII, can be seen this sclerite with the labrum removed. It has a delicate distal process, which is covered and protected by the labrum. The cross on figure 42 shows where the seta is joined to the sclerite on its inner surface. This sclerite is also sparsely covered with hairs. It can not be seen in caudal aspect until the maxillary sclerite has been removed. (Fig. 41, pl. XII.)

MAXILLARY SCLERITES. (Fig. 37A at *n*, pl. XI.) Situated laterad and below the mandibular sclerites are the maxillary sclerites. They too are curved, but on the front face are much narrower than mandibular sclerites. They form the lateral surface of the plane, however, and in caudal aspect are wide. (Fig. 40 at *x*, pl. XII.) Each sclerite bears two processes, one above the other, and both grooved on their outer edges to assist the setæ better on their way into the head. The processes are also concealed under the labrum. Figure 39, plate XII, shows the inner surface of the clypeus, mandibular sclerites, labrum, and epipharynx. Situated on the distal edge of the clypeus and at the base of the epipharynx is the heart-shaped *hypopharynx*. Its function seems to be to cover the setæ as they merge together and continue the tubular structure of the pharynx and enter the grooved trough of the epipharnyx.

LABIUM. (Fig. 37A, pl. XI; fig. 38B, pl. XII.) This is the beak in which lie the setæ. It is composed of three segments, the second of which in cephalic view appears longest, but in lateral aspect seems to be joined to the distal segment by a sort of socket joint, the dorsal edges of which are formed by this second segment and the distal segment set into this socket thus formed. (Fig. 38A, pl. XII.) The first segment of the beak, as it passes under the labrum, clypeus and maxillary sclerites, broadens until it seems to form the base of the caudal cavity of the head. This segment forms the floor of the mouth, and, although chitinized, it is flexible. It is supported down the middle by a chitinized rod (fig. 40 at *r*, pl. XII) coming from the bar and joining the tentorial sclerites. This rod extends the entire length of the beak, ending in the third segment. On dorsal side the labium is closed and flat, but on the ventral side its edges curve inward to form a groove or trough for the setæ. The first two segments of the beak are slightly

hirsute, but the distal one is furnished with heavy spines or sensorial hairs. The end of the beak is rounded and heavily chitinized, probably thus protected, as this portion rests upon the food-plant during feeding.

SETÆ. The setæ are four in number, one pair assigned to the mandibular processes and the other pair to the maxillary.

The inner pair of *maxillary setæ* are separated with difficulty, as they appear to be tightly grooved, forming a tube. The distal end of this pair extends beyond the other pair and projects out of the distal end of the beak. (Fig. 38B, pl. XII.) The distal ends of the maxillary setæ are smooth and hair-like, but curved slightly at the extreme tip. They lie between the other pair until the first segment of the head is reached, when they become caudad in position and separate from each other on either side of the pharynx, disappearing into the head cavity. The inner end of each seta is thickened and is joined to the inner surface of the top of the head by heavy muscles. From this muscle descends a muscle to the inner face of the maxillary sclerite. (Fig. 41, pl. XII.)

Mandibular Setæ.—These are heavier than the maxillary setæ, although not as long. The distal end is blunt and its outer edge or surface bears eight black teeth. (Fig. 37B, pl. XII.) The setæ lie laterad of and surround the maxillary setæ in their passage into the head, but on entering the head they lie cephalad. These mandibular setæ are thickened in the head and connected to the sclerites by a well articulating joint. (Figure 41 at *v*, pl. XII.) From this joint extends a heavy muscle, which branches into two as it nears the top of the head.

For further investigation, observations must be based on sections, both transverse and longitudinal. In making observations on sections to ascertain the structures of mouth parts, it seems to be advisable to begin at the distal end of the beak and carry our observations into the head, piece by piece.

The general shape of the beak or labium is transversely elliptical, the outline varying somewhat in the different segments. The back or dorsal side of the labium (the side which lies against the sternum) is protected and strengthened by a chitinized rod. (Fig. 40, pl. XII.) The labial wall on the ventral side comes almost together, and then curves inward, forming a groove in which the setæ lie.

In a section near the tip of the beak (fig. 46, pl. XIII) the groove is shallow and opens in front, allowing the setæ free and unhampered movement. In this section the maxillary setæ are found, as they are longer than the mandibular setæ, which do not always extend to the end of the beak; in fact, the maxillary setæ are frequently a full mm. longer than the beak. In this third segment the shape near the tip is circular. The supporting rod is not visible in the figure, but the dorsal wall is indentated slightly in the middle, and the rod probably plays in this indentation. The maxillary setæ here appear as one, but upon closer observation this structure appears to be made up of two sections tightly grooved on their inner surfaces. One seta is situated above the other throughout the entire line of the beak.

A section near the middle of the third segment is shown at figure 45, plate XIII. Here the shape is elongated dorso-ventrad. (Fig. 38A, pl. XI.) In this section we notice the presence of the mandibular setæ; they are crescent-shaped, folding around the maxillary setæ. As the sections proceed toward the head, the labium becomes more circular in shape until near the upper end of the second segment it seems to be almost a perfect circle. (Fig. 44, pl. XIII.) A clearer conception of the various parts may be seen in figure 43, plate XIII. The shape is elliptical laterad and the strengthening rod is very clearly present. The epipharynx completely closes the tube and protects the setæ. The mandibular setæ show an opening which has been noticeable in the other sections. The shape of the setæ is circular on its outer edge, but on the inner edge it is triangular. (See *e*, fig. 43, pl. XIII.) The ventral curve folds around the maxillary setæ. The maxillary setæ show the grooved structure on their inner edges.

By making observations on figure 38A, plate XI, the reader will ascertain that a cut made transversely on the beak will also cut transversely, or nearly so, across the mandibular and maxillary sclerites. Such a section is shown at figure 47, plate XIII. The setæ have become much larger than they were in the beak. The maxillary setæ have separated from each other (*x* and *d*, fig. 47, pl. XIII). The clypeus shows its various braces and pharyngeal muscles.

In a longitudinal section—that is, across the vertical plane—the cut will be parallel to the longitudinal line of the maxillary

and mandibular sclerites. Such a section is shown at figure 48, plate XIV.

MAXILLARY SETÆ. As the setæ enter the head they separate, going either side of the pharynx and extending to the top of the epicranium. The setæ widen as they approach this extremity. Each seta is fastened to the epicranial wall by a heavy muscle (*a*, fig. 48, pl. XIV), from which arises another muscle, which is attached to the upper side of the seta and forms the retractory muscle. Attached to the lower edge of the widened extremity of the seta is a pair of muscles, one of which is branched. This pair of muscles proceeds along the line of the seta and are attached to the inner surface of the maxillary sclerite at its distal end, thus forming the protractory muscles.

MANDIBULAR SETÆ. The mandibular setæ, in the head, lie laterad of the maxillary setæ. They do not extend as far into the head, as they are joined to the mandibular sclerite by an articulating joint. The seta is connected to the epicranial wall, however, by a very strong muscle, the retractor (*t*, fig. 48, pl. XIV). The protractor is shown at *n;* this muscle is branched at the end attached to the sclerite. This attachment is not visible in the figure. In this same section is shown a longi-section of the salivary ejaculator or pump of the suctorial apparatus. (See *c*, fig. 48, pl. XIV.) Connected to this pump are the ducts which supposedly lead to the salivary glands, although the glands have not been satisfactorily located by the writer.

THE PHARYNX may be seen in both the transverse and longitudinal sections, as it enters the head in such a manner that a cross section of it is obtained near the back of the head in a transverse section (fig. 47, pl. XIII) and turns downward, passing over the œsophagal ganglion, and is found again in longi-section.

GANGLIA. In longi-section and through the compound eyes near the top of the head (see fig. 49, pl. XIV) the subœsophagal and superœsophagal ganglion are shown, with the maxillary setæ on either side of the subganglion over which the pharynx passes. The superganglion, or upper brain, is extremely large in proportion to the head, and lies forward toward the front surface of the face or epicranium. Branching out on either side of this ganglion is a large optic nerve which leads to the compound eye. (See *o*, fig. 49, pl. XIV.)

An endeavor has been made to locate the nerves governing the mouth parts, but as yet without success.

CLYPEUS. In sections shown at figure 47, plate XIII, and figure 48, plate XIV, the heavy muscular tissues on the interior of the clypeus are seen. They are transverse and longitudinal muscles, which presumably regulate the muscular contraction and retraction of the upper part of the pharynx, and for this reason are called the *pharangeal muscles.*

Summary.

In a median lateral longitudinal section of the entire head and beak, a final and more comprehensive conception of the entire structure is presented. A careful study of this section, combined with the others just referred to, give the following results (fig. 50, pl. XV):

THE PHARYNX enters the head in a plane at an angle of about 60 degrees with the vertical or cephalic face of the head. It passes over the subœsophagal ganglion, and, turning suddenly downward, passes under the superœsophagal ganglion (see *b*). The pharynx proceeds toward the ventral face of the head until near the base of the distal end of the clypeus (*z*), when it turns sharply downward in a line parallel to the ventral face of the clypeus. At this turn the upper wall of the pharynx is formed by the hypopharynx (*h*), which joins itself to the epipharynx (*g*), lying beneath the labrum (*l*). The upper wall of the pharynx is expanded and compressed by the heavy muscles in the clypeus and labrum (*t, u, n*). The maxillary setæ (*x*) lie either side of the pharynx, gradually approaching each other until they meet, one lying over the other, forming a complete tube to continue the alimentary canal to the end of the maxillary setæ.

PUMP. (Fig. 50, *p*, pl. XV.) Situated below the pharynx is a fleshy bundle of muscles with an opening into a short duct, wihch appears closed at the forward end. From this duct are two smaller ducts (*k* and *o*, fig. 50), one leading into the pharynx, and the other presumably leading from the salivary glands.

BEAK OR LABIUM. The floor of the mouth is formed by the extension of the first segment of the beak (*f*, fig. 50, pl. XV), and is supplied with muscles near the curve of the first segment. These muscles are presumably used in lowering and raising the beak. Each segment has three pairs of lateral

muscles, and there are numerous muscles running longitudinally, which are not shown at figure 50, but may be seen in cross sections in figures 46 and 45 at *m, m,* plate XIII.

Running along the exterior surface of the floor and down the dorsal side of the beak is the chitinous rod used as a brace.

THORAX. The head is fastened to the prothorax by two muscles (*m-m,* fig. 40, pl. XII). It is fastened to the mesothorax by a pair of lateral muscles. The union with the mesothorax is completely covered by the prothorax with its lateral arms, back of the compound eyes.

Shape.—The prothorax may be seen in figure 61, plate XVI. It is compressed and the metopidium rises into a compressed and greatly elevated procephalon, which in lateral view is "spade-shaped." The dorsum is deeply sinuated at about one-third the way toward the posterior end. This sinuation forms the back of the procephalon and also the front edge of the dorsal hump. The color of the prothorax is a dull tan and brown, varying in the sex. The color markings differ in some respects, but this is fully discussed under the head of *Entylia sinuata,* in the systematic paper at the close of this treatise. The mesothorax and metathorax are shown in dorsal aspect at figure 1, plate V. Here the bullæ, or lobes, are to be seen; also the articulation of the tegmina and wings with the body. In each section (meso or meta) the scutum or bullæ are elevated and polished; much enlarged in comparison with the other segments, as they contain muscles used in flying. The præscutum, scutum, scutellum and postscutellum are marked and indicated on figure 1.

Tegmina.

The tegmina of *Entylia sinuata,* like all of the genera of the tribe Polyglytini, are punctate and darkly coriaceous in the costal, radial and first basal cells. In *Entylia sinuata* the punctating is dense and heavy, as is shown in figure 1, plate V, and figure 83, plate XX.

The veins in the tegmen seem to be pushed anteriorly, leaving a wide, unveined area below the first ulnar vein. The second ulnar vein disappears soon after leaving the base, but reappears near the posterior margin, where it appears in a hook-shaped line curving into the anal vein of the clavus. (Fig. 64, pl. XVII.)

The discoidal cells are small and only two in number, unless the vacant unveined portion be considered a discoidal. The first three apical cells are small, the third one petiolate, while the third and fourth are abnormally large. There is one, and possibly two, anals proceeding out of the base of the clavus. The tegmen is 3.8 mm. from base and 1.2 mm. wide in broadest portion.

Wings.

The wing is typical of the family, having the three longitudinal veins—costa, radia and ulnar—in corium, and two in clavus. It is difficult at times to see the second anal vein. The limbus surround the veined portion except at the base and along the costal area. Wing measures 2.2 mm. from base to tip.

Legs.

The prothoracic, mesothoracic and metathoracic legs, in all genera, differ greatly. The prothoracic leg has a heavy coxa, which is joined to the arm of the prothorax by a heavy membrane. The prothoracic leg is almost as large as the mesothoracic. The tibia, however, appears heavier in the prothoracic leg, presumably because the prothoracic leg is more developed through the aid it gives during feeding time. The femur of the prothoracic leg, as well as that of the mesothoracic, is much curved, especially the outer margin. The tibiæ are slender and quadrangular, haired and spineless. The claws are longer than those in the metathoracic leg; are sharp, bearing a soft, spongy cushion between them. This cushion is perhaps used as a suction in clinging to the plant, as the insect shows strong clinging abilities and is not easily shaken off its plant. In the prothoracic leg the tibia is scarcely longer than the femur, but in mesothoracic it is one third longer.

The metathoracic leg, or "jumping leg," is the member with which the insect does its rapid work in locomotion. The femur is cylindrical, but is not as curved on the outer edge as the femur in the prothoracic or mesothoracic leg. It is narrower in the middle than on either end, having a more forceful lever power than in the other shape. The tibia is at least twice the length of the femur. It is quadrangular, with numerous black, shining spines on the four angular edges and also on the planes between. There are also dark spines around the distal end of the tibia and on the first joint of the tarsus. (See fig. 2,

pl. V.) The tibia and tarsi are densely haired, and the tibia is larger at its distal end than in any other portion of its length.

The Abdomen.

The abdomen is composed of the typical ten segments (eight and the two forming the genitalia). It is compressed and has a ridge on its medial dorsal area. Each of the eight segments bears a pair of dark markings either side of the ridge. The first segment is narrower than the metathorax, thus giving the insect a marked constriction just back of the wings. The body line curves outward, the fourth segment being some little wider than the first or eighth. Viewed laterally the spiracles can be seen. (See fig. 54, pl. XV.)

The *genitalia* form a part of the abdomen and must here be discussed.

THE MALE GENITAL ORGANS, viewed laterally, present all the typical sclerites. (Fig. 52, pl. XIV.)

The *supra-anal* plate (*g*, fig. 52, pl. XIV) is joined to the eighth abdominal segment by a heavy membrane. Proceeding from the ventral side of the lateral face of the supra-anal plate is a sclerite which extends caudad beyond this plate. Its ventral edge curves upward, forming an apex with the dorsal edge on the caudal extremity of the sclerite. It is densely haired and flexible. This sclerite is a *cercus*, and has a mate on the opposite side of the insect. (Fig. 52, *p*, pl. XIV.) These are used as claspers.

Clasper.—The most ventral plate in lateral aspect is a clasper. It is narrowed posteriorly, hirsute, and also has a mate. (See *r*, at figs. 52 and 51, pl. XIV.) Proceeding from the inner side of the claspers are four polished, claw-like appendages (two on a side). The posterior pair are larger than the other pair, which, on the other hand, are darker than the posterior pair (*x*, fig. 52, pl. XIV).

In ventral aspect the *subgenital* plate (see *g*, fig. 51, pl. XIV) is seen. It is a fleshy sclerite, dentate twice on its ventral edge. The two pairs of claw-like organs are attached to the cerci beneath this plate.

The *anal* plate, in lateral aspect, is boot-shaped, pale, and hirsute. It is joined to the supra-anal plate by a membrane. (See *y*, fig. 52, pl. XIV.)

The *copulatory organ* is little seen in lateral aspect, as it is situated on the ventral side of the anal plate, and is closely attached thereto. In ventral aspect this organ is seen lying against the anal plate (*k*, fig. 51, pl. XIV). It is highly chitinized and dark, bearing a set of conspicuous, polished elevations.

THE FEMALE GENITAL ORGANS. *Ovipositors.*—The last ventral segment is triangular in its caudal edge, the sides sloping obliquely from the middle. Proceeding from under this sclerite is a pair of long, slender, highly chitinized plates (*o*, fig. 53, pl. XV). Near the ventral plate of the abdomen these plates enlarge or broaden and surround the vaginal opening. These slender sclerites are pointed at the caudal extremity, situated close together, forming a groove for the placing of the eggs. These are the ovipositors.

Either side of the ovipositors is another long, slender sclerite. This with its mate form the *egg guides* (*r*, fig. 53, pl. XV).

In lateral aspect (fig. 54, pl. XV) are seen the supra-anal plate at *g*, the subgenital at *gs*. the cerci or claspers at *r*, and the egg guides at *e*. The ventral plate is shown at *v*. In the female the subgenital plate lies beneath the anterior edge of the ovipositors. On its posterior edge it is double curved (*g*, fig. 53, pl. XV).

Technique.

Three processes of killing were used. First, the hot-water method: Boiling water was poured over the specimens and allowed to stand without further heating, for five minutes. At the end of this time dehydration was commenced, using increasing grades of alcohol from 30 per cent to 70 per cent, and left in 70 per cent for keeping.

The second method: Gilson's solution—acetic alcohol with sublimate (see Lee's *Vade Mecum*)—was poured over specimens and allowed to stand from fifteen to thirty minutes. The solution was washed out with claret solution or iodine in 85 per cent alcohol. This washing must be repeated several times for an hour or two until no trace of the odor of acetic acid can be detected. If this acetic acid remains in the specimen it will cause the insect to swell, and there is danger of the abdomen bursting. The claret solution is replaced by 70 per cent alcohol for keeping.

The third method was to kill in picro-aceto-sublimate (see *Vade Mecum*).

The last two methods were found more efficient in external and coarse dissection, as the sutures were more distinct and the muscles less brittle than in the water-killing. Before much work could be done in external anatomy of the head, it was necessary to clear the heads by boiling for fifteen minutes in one part saturate solution potassium hydrate and ten parts water.

For sectioning, any one of the three fixative methods seemed equally good. On account of the difficulty through the chitin, the material had to be softened in sodium hypochlorite solution (saturate solution, one part to ten parts water, was found satisfactory). The writer left the specimens over night (about fourteen hours) in this solution, and then dehydrated up to 85 per cent alcohol, from which the specimens were put into cedar oil for twenty-four hours or longer.

For infiltration, watch glasses were partially filled with melted paraffin. The specimens, before being placed in the paraffin, were drained on blotting paper. This process makes the change of paraffin unnecessary. The infiltration continued for ninety-six hours.

Sections were cut ten microns, stained three to four hours in Mayer's carmulum, and mounted in Canada balsam.

TAXONOMY.

The following synoptical table of the subfamilies of the Membracidæ is taken from Van Duzee (41), who uses that given by Canon Fowler, who founded his work formally on that of Stal:

Scutellum wanting or entirely concealed by pronotum..... 1
Scutellum distinct and more or less uncovered, with its apex nearly always excavated or broadly sinuated and furnished on each side with acute angles.....CENTROTINÆ Stal.
1. Tarsi of equal length, or posterior pair longest..... 2
Posterior tarsi much shorter than the anterior and intermediate .....HOPLOPHORINÆ Stal.
2. Tibiæ, at least the anterior and intermediate, dilated or foliaceous .....*II*—MEMBRACINÆ Stal.
Tibiæ simple or very slightly dilated, never foliaceous..... 3
3. Third apical or terminal areole of the corium elongated, never petiolate .....DARNINÆ Stal.
Third apical or terminal areole of the corium petiolate, the adjacent areoles contiguous before it 4

4. Elytra externally broadly coriaceous and opaque, with the veins of the coriaceous portion scarcely distinguishable, and the free margin broad .....TRAGOPINÆ Stal.
   Elytra entirely membranous, with the veins distinct or coriaceous and punctured at the base only.....*I*—SMILIINÆ Stal.

I.—SUBFAMILY SMILIINÆ* STAL.

The Smiliida are more northern in their contribution and form by far the greater portion of our North American fauna in this family.

Elytra free, with the clavus uncovered, its interior margin touching the external margin of the pronotum.....*1*—CERASINI Godg.
Clavus and frequently a part of the corium covered by the pronotum.. 1
1. Wings with the terminal areole sessile, its base truncated. *2*—TELAMONINI Godg.
   Wings with the terminal areole triangular, stylate..... 2
2. Base of the corium with two closely contiguous veins. *3*—POLYGLYPTINI Godg.
   Base of the corium with three veins, usually contiguous. *4*—SMILIINI Godg.

1.—Tribe CERASINI.

Corium with two veins contiguous at base, sometimes united in one.... 1
Corium with two distinct veins at base, contiguous at most, but for a short space at base, where they are subobsolete..... 2
1. Pronotum armed with suprahumeral horns, sometimes reduced to mere tubular angles .....1—*Ceresa* A. & S.
   Pronotum without suprahumeral horns, the sides of the metopidium, at most, obtusely angled.....2—*Stictocephala* Stal.
2. Elytra with five apical areoles, veins distinct....3—*Acutalis* Fairm.
   Elytra with four apical areoles, veins indistinct. 4—*Micrutalis* Fowler.

1.—Genus *Ceresa* A. & S.

In North America we find fifteen species, of which only three are recorded from Kansas. I give below a small key, based somewhat on that of Van Duzee (4):

A. Suprahumerals broad, stout and triangular.
   B. Elytra infuscated, metopidium pale, prothorax brown, transversely banded with pale near middle and a narrower pale marking near posterior process ..... 2—*diceros* Say
AA. Suprahumerals acute, distinctly produced as horns, triangular, sometimes short. Elytra very transparent. Species green when alive, turning to tawny or green mottled with tawny when dried. Prothorax covered with small white dots.
   B. Metopidium slightly curved cephalad between the suprahumerals; produced at times into an obtuse angle; sometimes flat but never concave.
      C. Clypeus short at apex, continuing contour of cheeks, 1—*bubalus* Fabr.
   BB. Metopidium concave between the suprahumerals, sometimes flat or a trifle convex in the very middle. Suprahumerals (viewed from above) subterete, sloping upward and curving slightly backward.
      C. Clypeus produced at apex, forming an angle in contour of cheeks. 3—*tauriana* Fitch

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* To accord with the general custom of term endings in subfamily names, I have changed the ending from IDA to INÆ.

1.—*Ceresa bubalus* Fabr. Figs. 5, 7, 10, 87.

Green when alive, turning to a tawny or an ochreous hue when dried. Finely punctured with obscure whitish dots. Pronotum bearing laterally two large horns called suprahumerals, in front of the lateral angles. These suprahumeral processes point outward but never upward; are dark brown at the tips and along the upper margin as far as the union with the prothorax. The metopidium rises perpendicularly from the head, but slopes gently toward the sides, leaving an apparent carina down the middle of the face of the metopidium. The metopidium slopes backward as well as slightly upward, and, with the dorsal margins of the suprahumerals, forms an equilateral triangle, the apex of which is at the dorsal carina. Laterally, the suprahumerals slope inward and backward, forming the lateral edges of the prothorax. The prothorax is produced into a sharply constricted point at the posterior process. The prothorax extends nearly to the tip of the tegmina but does not cover them laterally. The sides of the pronotum slope inward and upward, meeting the dorsal carina and forming a high tectiform hood. From the apex of the plane of the metopidium, the dorsum slopes downward and backward until it meets the sharp, black point of the posterior process. The pronotum, caudad of the metopidium, possesses a strong median longitudinal precurrent carina, slightly piceous in spots. The lateral edges of the prothorax are strongly carinated. The clypeus is not produced beyond the face but the lateral edges continue the contour. Tegmina tawny but transparent. The base of the clavus slightly coriaceous. Tibiæ quadrangular.

Length, 8 to 10 mm. Described from thirty specimens.

HABITAT: Brownsville, Tex.; Buffalo, Colo.; Kansas City, Mo.; Manchester, Vt.; Douglas, Sedgwick, Finney, Graham and Rawlins counties, Kansas; Eastern United States, Southern Canada, and extending west to California.

2.—*Ceresa diceros* Say. Figs. 6, 88.

Prothorax brown, finely punctured and mottled or banded with light tawny spots, usually two on each side, one pair about the middle of the dorsum and the other pair near the posterior process. This process is black and polished. The general shape of this species agrees with that of *Ceresa bubalus*, but the suprahumerals are broader and thicker. The front margin of the metopidium is not produced into an obtuse angle, but the cephalic margin of the suprahumerals curves gently outward and backward until near the middle of the front margin, when the line abruptly protrudes forward, producing a slight bump. The metopidium is pilose and is tawny in color. Tips of suprahumerals black.

Length, 8 to 10 mm. Described from seventeen specimens.

Amyot and Serville described this species as *C. post fasciata.*

HABITAT: Colorado Springs, Colo.; Pennsylvania; New York; Nova Scotia; Kansas City, Mo.; Douglas county, Kansas.

3.—*Ceresa taurina* Fitch. Figs. 8, 9.

Green when alive, turning tawny when dry. Agreeing in many particulars with *Ceresa bubalus*, but the species is more slender and smaller. Suprahumerals more acute, curving upward and a little forward, making

the front margin of the metopidium present a concave line. Clypeus usually produced below the face, causing a break in the contour of the ventral line.

Length, 7 to 8 mm. Described from twelve specimens.

HABITAT: Oak Creek canyon, Arizona; Lush, Wyo.; Columbia and Kansas City, Mo.; Welland county, Ontario; Colorado; North Carolina; Douglas, Sedgwick and Rawlins counties, Kansas.

2.—Genus *Stictocephala* Stal.

This genus comprises a large number of species. Van Duzee gives eleven species for North America, three of which occur in Kansas. The members of this genus, like *Ceresa*, are green when alive, turning to a yellow or orange hue, frequently mottled, when dry, and covered over with small white dots. Its characteristic differentiation from *Ceresa* is the absence of the produced horn-like suprahumerals.

A. Carinate sides of the metopidium meeting before the middle of the body.
  B. Metopidium, viewed from before, obviously widened upward to the rounded suprahumeral angles. Length of insect, 7.5 to 8 mm.
    C. Loræ continuing the rounded contour of the cheeks; the clypeus scarcely longer than the cheeks. Last ventral segment of the female broadly and subangularly excavate behind. Inhabits a region east of the continental divide..... 1—*inermis* Fabr.

AA. Carinate sides of the metopidium with no distinct meeting before the middle of the body.
  B. Metopidium, viewed from before, widened upward to the obtuse suprahumeral angles.
    C. Dorsum, viewed laterally, distinctly arcuate; metopidium high, its sides angulate or subangulate; distinctly carinate, uniting somewhat behind the middle of the dorsum. Face evenly and regularly punctate, carinæ frequently rufous..... 3—*festina* Say

  BB. Metopidium regularly narrowing above the suprahumerals.
    C. Carinate sides of the metopidium meeting at or near the middle. Dorsum elevated. Face smoothly corrugated, evenly and closely punctate. Clypeus and loræ little produced. Length of insect, 6 to 6.5 mm.
      D. Pectus and outer face of femora black; clypeus briefly but obviously produced beyond the lines of the cheeks. 2—*lutea* Walk.

1.—*Stictocephala inermis* Fabr. Figs. 16, 17, 66 and 89.

This is the largest species of the genus. In cephalic aspect, the metopidium shows slight obtuse suprahumerals, but these are in no case produced as in *Ceresa*. The metopidium rises from the head in a perpendicular plane, which almost immediately inclines slightly forward, causing the front of the metopidium, when viewed laterally, to present a curved surface. The metopidium, above the line of the suprahumerals, curves gently backward. Cephalad of the middle of the pronotum, the plane of the metopidium is terminated by the union of the dorsal carinæ of the suprahumerals, thus forming an isosceles triangular plate as in *Ceresa*. From this point the dorsum slopes gently downward and backward to meet the posterior process, which is usually dark and always acute. The dorsum bears a longitudinal median carina, which is sometimes rufous or dotted with light brown. The sides of the pronotum are concave or inwardly arcuated, and the ventral line, which is carinated, slopes rapidly

to meet the constricted posterior process. The tegmina are slightly colored with dark coriaceous spots at the base. The pectus and outer face of femora black, but frequently light and concolorous.

Length, 7 to 9 mm. Described from twenty-five specimens.

HABITAT: Oak Creek canyon, Arizona; Trenton Falls, N. Y.; Kansas City, Mo.; Oregon (Canada mountains); Douglas and Cowley counties, Kansas.

2.—*Stictocephala lutea* Walk. Figs. 28, 29, 90.

This species, although commonly found and reported from Kansas, has not been collected by the writer. Therefore, this description is based on museum material only. It is somewhat smaller than *S. inermis*, but as the two species intergrade to a considerable degree, it is difficult to draw a fast and positive line between them. The specific differentiation of *lutea* from *inermis* lies in the convex metopidium (with its slightly and delicately carinated edges), which in *S. lutea* has its apex caudad of the middle of the pronotum. The dorsum is high and the sides well arcuated. The pectus and outer face of the femora are black.

Length, 7 to 7.5 mm. Described from twelve specimens.

HABITAT: Alabama; Mississippi; Arizona; Hayti; Sedgwick and Douglas counties, Kansas.

3.—*Stictocephala festina* Say.

The material at my disposal was accidentally injured, so that no detailed description can be given at this time.

3.—Genus *Acutalis* Fairmaire.

This genus is distinguished from *Micrutalis* by the fact that the *Acutalis* tegmina have five apical cells, while *Micrutalis* has but four. (See figs. 80, 81, 82.) There has been some question among investigators concerning the advisability of separating these two into different genera. The tegminal characters, however, would seem to be of generic value.

Van Duzee gives three species common to North America, but up to this time only one has been collected in Kansas.

Acutalis tartarea Say. Figs. 18, 19, 80.

Pronotum black and shiny. Metopidium rising perpendicularly for a short distance and then curving gently back over the abdomen. Small, inconspicuous suprahumerals, light in color. Lateral edges of pronotum light, extending to the posterior process, which is compressed into a point. Posterior process pale. Face black and shiny; compound eyes and ocelli light. Tegmina black with a purplish iridescence as far as the apical region, where the tegmina become transparent; nervules heavy. Metathoracic legs are heavily spined and of a greenish hue; other legs pale yellow, hirsute, and with a dark spot on the distal end of the tibiæ.

Length, 4 to 5.5 mm. Described from fifteen specimens.

HABITAT: Virginia and Douglas county, Kansas. Van Duzee gives the species as common throughout the Middle Atlantic States, and northward through New York to Canada.

4.—Genus *Micrutalis* Fowler.

This genus has only four apical cells in the tegmina. Frequently, as in *M. dorsalis* (a species, according to Van Duzee, not reported from Kansas), there is a fifth terminal areole; but this is not formed in the regular way, but by the crowding of this nervure against that forming the apex of the costal areole. In the Francis Huntington Snow collection at the University of Kansas the genus does not seem to be represented. It is there, however, but included in *Acutalis*, on account of the older manner of classification. The specimens labeled *Acutalis calva* and *Acutalis occidentalis* the writer classifies *Micrutalis*, on account of the four apical cells.

Van Duzee records six species from North America.

In the smaller and more typical species of this genus the terminal areole may be small, or even wanting.

Genus *Micrutalis* Fowler.

A. Size small; less than 4 mm., but more than 2.5 mm.
  B. Pacific coast species, pronotum, when viewed dorsally, slightly rounded, at least not acute, on edges before posterior process.
    C. Color pale, the dorsum sometimes marked with a brown median line, which may be expanded between the suprahumerals and before the apex ..... 1—*occidentalis* Godg.
  BB. Eastern species, with pronotum, viewed dorsally, with edges continuing the line directly with that of the posterior process. Pronotum relatively more acute than in the former.
    C. Black marking much extended; the pronotum usually entirely black except at tip. In pale specimens the color of the dorsum is gathered anteriorly, and does not form a dorsal line widening before the apex ..... 2—*calva* Say

1.—*Micrutalis occcidentalis* Goding. Fig. 81.

Although this species seems to be accredited to the Pacific coast, the F. H. S. collection records it from Brownsville, Tex. This fall (1911) the writer found one specimen in sweepings at Lawrence, Kan.

It is a small, pale species, in some cases almost void of color markings. In cases of this kind there is a slight collection of light brown color near the cephalic end of the pronotum. In other specimens this color may be dark and extend about midway to the tip of the pronotum.

Length, 2.8 to 3.2 mm. Described from seven specimens.

HABITAT: Brownsville, Tex.; Riverside, Cal.; Lawrence, Kan.

2.—*Micrutalis calva* Say. Figs. 20, 21, 82.

Prothorax smooth, black, and shiny. Posterior process, face and compound eyes pale. There are small, obscure, obtuse suprahumerals outlined with a pale yellow carina. Femora black. Tibiæ bear dark spots near femora. Tegmina clear, with pale but distinct neuration.

Length 3 to 3.5 mm. Described from ten specimens. Redescribed as *Smila flavipinnis* by Germar.

HABITAT (Van Duzee): Of wide distribution from southern New York to Florida, and west to the Rocky Mountains. F. H. S. collection records specimens collected in Texas, Missouri, and Kansas.

2.—Tribe TELAMONINI Godg.

A. Pronotum unarmed.
  B. Dorsum strongly compressed foliaceous..... 1—*Archasia* Stal
AA. Pronotum armed with a horn or dorsal crest more or less developed.
  B. Dorsum armed with a compressed horn, which is erect or nearly so, with a dorsal crest more or less elevated.
    C. Dorsal crest arising from behind the suprahumerals. If distinctly elevated, wider than high. Corium coriaceous, and if at all punctured only for a short space at the base.
      D. Dorsal crest rounded; obtusely pointed, truncate or sinuate at apex, sometimes scarcely elevated..... 2—*Telamona* Fitch

1.—Genus *Archasia* Stal.

A genus whose species are green when alive, turning orcheous or tawny in museum specimens. Prothorax punctate and finely although obscurely dotted with white specks. Longitudinal median carina piceous in spots. Prothorax very highly elevated and compressed into a sharp helmet above the head.

Archasia galeata Fabricus. Figs. 22, 23.

This is the only species of this genus reported from Kansas. There are two species classified by Van Duzee, but the F. H. S. collection yields but one specimen of each of the two species, and *A. belfragi* is not reported from Kansas. On account of the scanty material, very little study could be made.

Contour of the prothorax entire, not having elevations or sinuations. Metopidium bears short, obtuse suprahumerals.

HABITAT: Van Duzee reports the species from Colorado and Georgia, stating that it is less abundant than *A. belfragii* Stal in the Northern States, but is a prevailing form in the South. The specimen in the F. H. S. collection is from Douglas county, Kansas.

Length, 9.5 mm.

2.—Genus *Telamona* Fitch.

This genus contains the largest form found in Kansas, it measuring sometimes 11 mm. in length. The male is much smaller than the female and also darker in color.

A. Crest (viewed laterally) pyramidal, rather slender and narrowed upward.
  B. Crest narrowing above to a rounded point, posterior angle scarcely if at all indicated, its front sloping from the metopidium without a sinus at the anterior base .....1—*pyramidata* Uhl.
AA. Crest (viewed laterally) rectangular, broad, but little narrowed above.
  B. Crest nearly vertical before or sometimes overhanging. Gray or brownish species more or less distinctly banded or dotted with dark brown, sometimes almost black.
    C. Crest truncated above, the angles nearly or quite right angles.
2—*ampelopsides* Harris

1.—*Telamona pyramidata* Uhler. Figs. 30, 31, 84.

Color varying from a pale, tawny concolorous specimen through greenish ochre to brown with darker markings. In cephalic aspect the form is very broad and somewhat flat; the metopidium curves backward after rising perpendicularly for a short distance, and gently upward, forming a dorsal elevation back of the suprahumerals. This elevation or protuberance slopes abrubtly downward and then proceeds in an almost hori-

zontal line to the posterior process. The dorsal carina is prominent and piceous as far as the elevation, but caudad it becomes concolorous and obscure. There is frequently a dark color marking extending from back of the elevation to the lateral edge of the prothorax, slanting slightly caudad. End of prothorax diffused with dark. Tegmina transparent, except for the dark tip and slight coriation of base. Cephalic portion of the prothorax pale. Suprahumerals sometimes dark at the tips.

HABITAT: Colorado Springs, Colo.; Cheyenne, Douglas and Gove counties, Kansas; Missouri.

Length, 10.2 to 8.5 mm. Described from twenty-five specimens.

2.—*Telamona ampelopsides* Harris. Figs. 73, 74.

Redescribed as *Thelia cyrtops* by Fairmaire.

Color dark dusty brown, some specimens having a greenish cast in the lighter portions. Metopidium rising similar to that in *T. pyramidata*, but instead of sloping gently backward it rises abruptly to form the high rectangular dorsal elevation. The dorsal contour of this protuberance runs backward in an almost horizontal yet slightly descending plane until past the middle of the prothorax, when it slopes suddenly downward and then extends caudad, forming a lanceolate posterior process. Color, dark brown, the cephalic face of the suprahumerals bearing a splotch which extends toward but does not attain the median carina. This median carina is piceous. The cephalic edge of the elevation has color markings which extend downward and backward to meet the splotch at the caudal edge of the elevation on the side of the prothorax. This color may or may not extend as far as the posterior process, which is dark. Median carina is dark and prominent for its entire length. Femora dark on dorsal side. Tegmina smoky and darker at tip; clear in costal region. The males in this species are much darker than the females, being at times almost black, but with the markings visible.

Length, 11 mm. to 8.8 mm. Described from forty specimens.

HABITAT: Menand, N. Y.; Kansas City, Mo.; Manchester, Vt.; Douglas county, Kansas.

3.—Tribe POLYGLYPTINI Goding.

A. Pronotum usually not produced anteriorly; if at all, only very slightly.
  B. Dorsum regularly rounded transversely, punctate; prothorax not elevated in rugæ. The furcation forming the base of the terminal areole is a straight line or nearly so ..... 1—*Vandusea* Goding
  BB. Dorsum more or less elevated; the surface with longitudinal rugæ, which may become more or less reticulated; the furcation forming the base of the terminal areole forming an angle.
    C. Dorsum strongly elevated, compressed, with a deep sinus whose base is rounded ..... 2—*Entylia* Germ.
    CC. Dorsum but slightly elevated; a little sinuated before the middle, the base of the sinuation being flat or angled, not regularly rounded. 3—*Publilia* Stal

1.—Genus *Vanduzea* Goding.

This genus may be distinguished by the absence of wrinkes or rugæ on the prothorax and by the peculiar shape of the terminal areole or third apical cell, which has a straight vein for a base instead of the

usual angle toward the base of the tegmen. The metopidium is not produced any higher than is absolutely necessary to cover the mesothorax and metathorax.

In the species common to Kansas the dorsum is transversely rounded and punctate. Van Duzee states that some species of this genus have the dorsum carinated and sinuated.

The color of the species of the genus *Vanduzea* is mottled with dark, either dark brown or black, with whitish or light oblique vittæ. The prothorax is pilose, the legs dark brown to black, with light hairs. The tegmina, except in the costal region, is transparent, the nervules with black or brown dotted lines. The tip of the limbus is infuscated.

Vanduzea arquata Goding. Figs. 14, 15, 68, 69, 78.

Color reddish brown, verging to black. There are white or light yellow markings or vittæ, an oblique spot joining the lateral margin, and a line just before the posterior process. Sometimes there is a small white spot on the dorsum almost concurrent with the spots on the sides. The pronotum bears no procephalon or crest and is smoothly rounded transversely. The metopidium rises slightly from the head and then curves gently backward to the dorsum, which is slightly arcuated to the posterior process. The metopidium (in cephalic view) is broad, with short, obtuse suprahumerals. Head and body and legs dark and pilose.

Length 5.1 to 4.5 mm.

HABITAT: Galveston and Brownsville, Tex.; Douglas and Congress Junction, Ariz.; Kansas City, Mo.; Kansas City, Kan.; Morton, Clark, Douglas, Stevens, Seward and Haskell counties, Kansas.

According to the determination in F. H. S. collection, there are two species common to Kansas, *V. arquata* and *V. vestita*. Van Duzee separates these species by the costal region of the tegmina. *V. arquata* has the costal cell coriaceous and punctured for nearly its whole length; *V. vestita* has the costal areole or cell concolorous, sparsely punctate near the base. If this classification be true—and I have every reason to consider it such—then there is but one species in the F. H. S. collection, as all the specimens agree with *V. arquata*. In Van Duzee's description of *V. arquata* he states that the suprahumerals are more prominent than in *V. arquata*. With this description as a basis, the specimens here can not be *V. vestita*, as there is no ascertainable difference in the prominence of the suprahumerals.

Genus *Entylia* Germ.

This genus has received a considerable list of synonyms, which I append at the close of the description of species. It is widely distributed east of the Rocky Mountains, and some species occur in considerable numbers, the writer having found extensive colonies in Kansas and Vermont.

The metopidium of the prothorax rises in a high elevation to form a distinct procephalon, almost perpendicular or sloping slightly forward on its cephalic edge. This procephalon is greatly compressed and extends rectilinearly caudad for a short distance, descending suddenly and abruptly into a deep sinus smoothly curved at the base. This sinus

forms also the front of a second elevation, or the dorsal hump, which does not rise as high as the procephalon, but is equally compressed, slopes down rapidly, making the dorsal hump, in lateral aspect, appear somewhat rectangular. After dropping for a distance about equal to the depth of the curved sinus, the dorsal line proceeds gently backward and downward to meet the blunt posterior process.

Entylia sinuata Fabr. Figs. 61, 62, 64, 83.

In looking over the individuals of this genus in F. H. S. collection, I find two species, or rather one species and a variety, *Entylia sinuata* and *Entylia sinuata* var. *bactriana*. Upon closer examination the writer finds that those determined as *E. bactriana* are all males, and those determined as *E. sinuata* are all females. In the life-history observations (recorded in this paper) the writer found the males agreeing with *bactriana* and the females agreeing with *sinuata*. F. C. Crawford, associate curator, division of insects, United States National Museum, states that there are both males and females of both species and variety in the collection there. From this information, and the study of life history, it may be inferred that there has been an error in the determination of the material in the F. H. S. collection. Whether that is a correct statement or not, the fact remains the same—that the writer has not found any *E. sinuata* var. *bactriana* in Kansas.

It is not necessary to redescribe the procephalon and dorsum of this species, as it agrees with that given in the generic characters. The sides of the prothorax bear three lateral carinæ, the central one being branched at its base in such a manner as to frequently appear as two. The lower one forms the edge of the prothorax, while the upper branches into the posterior elevations. These carinæ frequently appear white, especially in the males. There is a prominent dorsal carina which extends from the base of the metopidium, follows the elevations in their sinuations, and finally fades out on the posterior process. The prothorax extends beyond and covers the tips of tegmina. The tegmina are transparent except in the basal region of the three longitudinal veins in the corium; this region is dark and heavily coriaceous. The discoidal cells are small and pushed costad and distad, leaving the lower part of the corium unveined. The tips of the tegmina are infuscated. The suprahumerals are distinct, obtuse, and not formed by any marked invaginations in the outline of the prothorax.

The male is dark, almost black, with procephalon slightly less elevated than in the female. The face heavily punctate. As a rule, the male is smaller than that of the female. The female is light brown or tan, mottled with dark anteriorly. The front of the head and procephalon is densely spotted with irregular dark markings, and there is an arcuate dark mark on the sides of the prothorax behind the middle, with the posterior end infuscated. The body usually accords in shade to the main color of the prothorax; the legs pale. There are variations in this color marking, as the front of the face and prothorax, including the cephalic elevation or procephalon, may be pale, as usual, but the sides of the prothorax, including the dorsal hump, may be very dark, the caudal third of the prothorax being light, infuscated at the extreme

tip. Legs pale; body dark. Sometimes the color markings do not take definite shape, but appear in mottled splotches. Again, the procephalon may be light in color, continuing on to the sides of the prothorax and forming a cephalocaudal band meeting the light caudal third, thus leaving only the tip of the cephalic elevation and the sides of the dorsal elevation dark.

Length: Males, 3.3 to 5.1 mm.; females, 5.2 to 6.1 mm. Described from sixty-three specimens.

HABITAT: Manchester, Vt.; Maine; Kansas City, Mo.; Brownsville, and Galveston, Tex.; Douglas, Sedgwick, Reno and Neosho counties, Kansas; New York.

Synonyms:

1798—*Membracis sinuata* Fabr. Ent. Syst. Suppl.
1798—*Membracis emarginata.*
1803—*Membracis emarginata* Fabr. Syst. Phyng.
1851—*Entylia concisa* Walk. List. Hom. B. M.
1851—*Entylia decisa* Walk. List. Hom. B. M.
1851—*Entylia accisa* Walk. List. Hom. B. M.
1851—*Entilia torva* var. Fitch. Cat. Hom. N. Y.
1851—*Entilia torva* Walk. List. Hom. B. M.
1876—*Entilia carinata* Glover. Rep. U. S. Dept. Agril. No. 29.

At the close of the Synonimical Catalogue occurs the following habitat: New York, Missouri, New Hampshire, Virginia, District of Columbia, South Carolina, North Carolina, Pennyslvania, Michigan, Iowa, Maryland, Florida, Illinois.

3.—Genus *Publilia* Stal.

This genus has been formed by Stal for the reception of those species formally classed as *Entylia*, where the elevations are not high enough to put the form strictly into genus *Entylia*, but in which the dorsum is similarly sinuated. Kansas contributes two species to the genus.

A. Dorsum straight or feebly bowed, scarcely if at all sinuated, form slender, prothorax punctate, not wrinkled ..... 2—*modesta* Uhler
AA. Dorsum elevated, obviously sinuated.
B. Sides of the prothorax with longitudinal wrinkles which form a network along the dorsum ..... 1—*concava* Say

1.—*Publilia concava* Say. Figs. 26, 27, 65.

A small, dark form with a very roughly punctated and coarsely reticulated pronotum, which almost covers the tegmina laterally. The metopidium is slightly elevated, being compressed and in cephalic aspect appears as a heavy carina or minute procephalon above the cephalic face of the metopidium. The sinus on the dorsum is obvious, although not as marked as in *Entylia sinuata;* the base is flat or angulated, not a regular curve. The dorsal crest is not abrupt caudad, but curves gently to the posterior process. Along the sides of the prothorax are distinct carinæ, which become forked anteriorly and dorsally, forming a network of veins.

This species is dark, mottled slightly with pale, and there is a light vitta on the side below the sinus, and a large spot on the lateral edge behind the middle, extending upward toward the dorsal crest, but not

extending to it. At the back of the dorsal crest is a narrow transverse line of a pale color, or there may be a reticulation.

Length, 6 to 5 mm. Described from ten specimens.

HABITAT: Maine; Kansas City, Mo.; New York; Douglas county, Kansas.

2.—*Publilia modesta* Uhler. Figs. 32, 33.

A comparatively pale species, with prothorax entirely covering the abdomen and tips of tegmina, leaving only the costal region exposed. The dorsal sinus is very slight, sometimes almost entirely absent. The metopidium is not elevated into a procephalon of any degree, but is transversely rounded, the dorsal crest not apparent. Dorsum only slightly arcuated. Body dark, with femora black and shiny; frequently body light and legs pale. Pronotum with lateral carinæ indistinct, and very slight, if any, reticulation; closely punctate.

Color variable. There are some individuals which are pale green, with only the front of head and metopidium mottled with dark, or the form may be brownish, with face still darker. The sides of the prothorax with two pale spots, one large one near the front, and an oblique line near the posterior process, concurrent across the dorsum. Frequently these pale spots are a light yellow. There is a white or grey variation, with head and front of metopidium dark grey, the posterior process and an oblique band on the prothorax also grey. A few forms are almost pure white, being only inconspicuously mottled, and this on the dorsal carina. In these vary pale specimens the costal region of the tegmina is the same shade as the ground color of the pronotum, and is coriaceous.

The nymphs have sharp, shiny dorsal tubercles on the abdomen. The enlargements of the head and prothorax are hirsute. *P. bicinctura* Godg., as determined in F. H. S. collection, appears to agree with the grey variation of *P. modesta*.

Length, 4.5 to 5.1 mm. Described from seventeen specimens.

HABITAT: Albuquerque, N. M.; Colorado Springs, Colo.; Gove and Rawlins counties, Kansas.

4.—Tribe SMILIINI Goding.

In this tribe we find four genera—*Smiliia* Germ., *Ophiderma* Fairnm., *Antianthe* Fowler, and *Cyrtolobus* Goding. Of these, only *Cyrtolobus* is reported from Kansas. The last three genera are separated from the first, *Smiliia*, by the presence of a transverse nervule between the two inner longitudinal veins, which is absent in *Smilia*. *Cyrtolobus* and *Antianthe* are separated from *Ophiderma* by the strongly compressed pronotum, as *Ophiderma* is not at all compressed and the dorsum is rounded transversely. Again, *Cyrtolobus* is differentiated from *Antianthe* by the absence of the strongly produced suprahumerals so evident in *Antianthe*. In *Cyrtolobus* there are small suprahumerals and the dorsum is highest at about the middle.

Students in this subject have seen fit to divide the genus *Cyrtolobus* into the subgenera *Xantholobus* V. D., *Evashmeadea* Godg., *Atymna* Stal, and *Cyrtolobus* Godg. *Xantholobus* is separated from the others by its posteriorly inflated pronotum. *Atymna* and *Cyrtolobus* differ from

Evashmeadea Godg. by the lack of sinuation on the dorsal crest. *Atymna* and *Cyrtolobus* are differentiated by the position of the highest portion of the crest. In *Atymna* the highest portion of the crest is anterior to to dorsum, rising above the humeral angles, while in *Cyrtolobus* the highest portion of the crest is near the middle of the dorsum.

Of this subgenus Kansas has recorded but one species, *Cyrtolobus vau* Say. Figs. 24, 25, 79.

This species is pale brown or tan; frequently banded with both darker and lighter shades than the ground color. The crest is evenly arcuated, and in some cases very little elevated. The metopidium is transversely rounded, the crest beginning to rise back of the humeral angles. The dorsum is rounded from its ventral edges and the crest is formed by a sharp compression. At times this crest is made manifest only by a distinct and prominent median dorsal carina. The pronotum does not extend to the tips of the tegmina, but covers the abdomen. The carina is usually darker than the rest of the pronotum. The color marking, when present, consists of three dark spots along the lateral side of the dorsum, cut into by two streaks of light on the crest or carina, but joined together on the lower edge of the side of the dorsum. Posterior process is light if the color markings are present; otherwise it is light and concolorous with the pronotum. The face is usually void of color markings, and is short, with a broad clypeus rounded at the apex, and black, shiny, compound eyes. Legs pale and slender; pectus pale. Tegmina distinctly veined and transparent except near the tip, where it commences to become smoky, and continues so to the very tip.

Length, 6.5 to 5 mm.

HABITAT: Colorado Springs, Colo.; Kansas City, Mo.; Columbia, Mo.; Pennsylvania.; Douglas county, Kansas.

II.—SUBFAMILY MEMBRACINÆ STAL.

This subfamily is differentiated from the others by the dilated or foliaceous tibiæ. In this subfamily are placed the two genera *Enchenopa* and *Campylenchia*, which together are separated from the other members of the subfamily by the pronotum being distinctly compressed and elevated toward the front into a prominent, usually oblique process. This process is further characterized by the lateral carinæ attaining the middle of the posterior process.

The two genera are separated from each other by the position of the lateral carinae:

A. Lateral carinæ of the anterior process simple, placed about equally distant from the upper and lower margins. Carinæ foliaceous. Pronotum without pubescence. 1—*Enchenopa* A. & S.

AA. Lateral carinæ of the anterior process with several branches. Carinæ placed a little nearer the dorsal margin; the inferior carina not foliaceous. Pronotum with appressed pubescence ..... 2—*Campylenchia* Stal

1.—Genus *Enchenopa* A. & S. Figs. 12, 13, 71, 85.

In this genus Kansas has recorded but one species. This one, however, is very common and of wide distribution. *Enchenopa binotata* Say may be distinguished from the other species of this genus by its dorsal carina being very prominent posteriorly. The insect is of a reddish brown, while

its near relative, *permutata,* is pale yellow. The color of the prothorax may at times be almost black. The dorsal carina is extremely elevated and continues prominent to the tip of the posterior process.

The metopidium bears a procephalon or anterior horn, which is usually larger at its anterior extremity than where it joins the pronotum. This horn seems to rise obliquely forward from the pronotum for some distance and then turn suddenly forward in a line parallel with the dorsal carina, thus forming a "bump" at the end of the horn. The procephalon is distinctly compressed, and the dorsal carina extends into the procephalon and follows the median line even into the cephalic face.

On the sides of the prothorax, but so close to the dorsal carnia that they extend over and meet the spots on the opposite side, are two long, slender spots, extending for some distance laterally. This is the character which probably gives the species its name. The posterior process is dark and very acute. The tegmina are entirely dark reddish brown with a smoky translucency. The wings are transparent. The body and pectus dark reddish brown. The tibiæ of the prothoracic and mesothoracic legs are dilated; the metathoracic grooved on its outer side and spined along the two outer edges.

Described by Buckton as *Enchenopa prorecta,* and by Walker as *Enchenopa brevis.*

Length, 5.5 to 7.4 mm. Described from over 100 specimens.

HABITAT: Missouri; Pennsylvania; Taxas; Manchester, Vt.; Canada; Douglas and Sedgwick counties, Kansas.

2.—*Campylenchia curvata* Fabr. Figs. 70, 11, 86.

This species is a dusky reddish brown, with a procephalon or horn protruding obliquely over the face for a distance about equal to the pronotum, measuring from the suprahumerals posteriorly. The dorsal carina is not greatly elevated, but the lateral carinæ are distinct and extend from the tip of the procephalon into the posterior process, which is acute. The pronotum is concolorous; the tibiæ, as in *Enchenopa binotata,* are dilated. The tegmina smoky, coriaceous in the costal region and on the basal cells. Pectus dark and eyes light.

Length, 8 to 9 mm. Described from over 100 specimens.

HABITAT: Colorado; Missouri; Canada; Douglas county, Kansas.

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FOOD PLANTS.

Ceresa bubalus.

Osage orange ..... *Maclura aurantiaca* Nutt.
Horse radish ..... *Nasturtium armoracia* Fries.
Gama grass ..... *Tripsacum dactyloides* L.
Sunflower ..... *Helianthus annuus* L.
Alfalfa ..... *Medicago sativa* L.
(Reported by Riley on apple and potato.)

Acutalis tartarea.

Horse ragweed ..... *Ambrosia trifida* L.

Ceresa taurina.

Horse radish ..... *Nasturtium armoracia* Fries.
Choke cherry ..... *Prunus arbutifolia* L.

Ceresa diceros.

Elderberry bushes.

Campylenchia curvata.

Goldenrod ..... *Solidago canadensis* L.
Sensitive rose ..... *Cassia nicitans* L.

Enchenopa binotata.

Goldenrod ..... *Solidago canadensis* L.
Pin oak ..... *Quercus palustris* Du Roi.
Bittersweet ..... *Solanum dulcamara* L.

Entylia sinuata.

Sweet clover ..... *Melilotus alba* Lam.
Thistle ..... *Cnicus altissimus* Willd.
Cat-tail grass ..... *Phleum alpinum* L.
Sunflower ..... *Helianthus annuus* L.
Alfalfa ..... *Medicago sativa* L.
Spikenard ..... *Ambrosia* sp.

Publilia concava.

Pin oak ..... *Quercus palustris* Du Ror.
Sycamore ..... *Platanus occidentalis* L.

Publilia modesta.

——— ..... *Berlandiera texana.*

Stictocephala inermis.

Gama grass ..... *Tripsacum dactyloides* L.

Telamona ampelopsides.

Woodbine or Virginia creeper..... *Ampelopsis quinuefolia* Michx.

Alfalfa ..... *Medicago sativa.*
Ceresa bubalus.
Entylia sinuata.
Berlandiera texana.
Publilia modesta.
Bittersweet ..... *Solanum delcamara.*
Enchenopa binotata.
Cat-tail grass ..... *Phleum alpinum.*
Entylia sinuata.

Choke cherry ..... *Prunus arbutifolia.*
Ceresa taurina.
Gama grass ..... *Tripsacum dactyloides.*
Ceresa bubalus.
Stictocephala inermis.
Goldenrod ..... *Solidago canadensis.*
Campylenchia curvata.
Enchenopa binotata.
Horseradish ..... *Nasturtium armoracia* Fries.
Ceresa bubalus.
Ceresa taurina.
Osage orange ..... *Maclura aurantiaca.*
Ceresa bubalus.
Pin oak ..... *Quercus palustris.*
Enchenopa binotata.
Publilia concava.
Sweet clover ..... *Melilotus alba.*
Entylia sinuata.
Sensitive rose ..... *Cassia nictans.*
Campylenchia curvata.
Sycamore ..... *Platanus occidentalis.*
Publilia concava.
Sunflower ..... *Helianthus annuus.*
Ceresa bubalus.
Entylia sinuata.
Thistle ..... *Cnicus altissimus.*
Entylia sinuata.
Virginia creeper ..... *Ampelopsis quinquefolia.*
Telamona ampelopsides.
Woodbine—See Virginia creeper.

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